EXACT

TYPE 200
WAVEFORM SYNTHESIZER
AND
PLUG-IN GENERATORS

200/C

OPERATING PROCEDURE

The triggering of the basic increments as well as the amplitude and configuration of the final output is controlled by the Plug-in generator used. Therefore, a more complete operational procedure will be described under the "OPERATING PROCEDURE" section of the Plug-in generator itself.

I. OPERATING SEQUENCE

The levels are switched in forward sequence only, starting with the upper left hand corner. This would be row A, increment #1. Each trigger from the plug-in switches to the next successive horizontal increment #2, #3.....#10; at this point the next trigger switches to the next lower horizontal row or row B*, increment #1 and repeats as in row A. There is no time interval between the 50th increment and 1st increment except for the risetime itself which is constant.

* An entire row may be switched out and thereby eliminated completely. If, for instance, row B were turned OFF, the next trigger would cause the unit to switch from Row A, increment #10 to Row C, increment #1.

CAUTION: Level switching is done by ring counters and if you turn a Row switch to OFF while that particular row is still switching, the unit will continue to run on that row only. If this happens turn the Row switch ON then OFF again or go to a slower TIME/INCREMENT speed where it is easy to observe the operation of the rows.

II. NEON INDICATION

The neon indicators show which decade row is on and also the individual increment being switched.

CALIBRATION PROCEDURE & MAINTENANCE GUIDE

This is the calibration procedure used at the factory which assures that the stated operational specifications can be met. We hope that you will find it useful for recalibration as well as in periodic trouble shooting and maintenance.

The trouble shooting suggestions have been arranged in order of progressive calibration. This is to allow you to more easily isolate the malfunction by its place in the sequence of operation. Since many later steps depend on the proper performance of prior operations, it would be most wise to check back to the beginning on all troubles and eliminate this possibility. For example if you have instability of several increments you might suspect the matrix or, quite logically, the trigger circuits. However, the trouble might well be the -210 volt power supply out of regulation. Eliminate fundamental problems (such as the power cord being plugged in!) before trouble shooting specific areas.

All tests should be made with a voltmeter having 20,000 ohms/volt and a dependable oscilloscope with the following characteristics.

(a) Input impedance at least 1 Megohm
(b) Horizontal sweep accuracy - 3%
(c) Capable of being externally triggered

CALIBRATION SEQUENCE — IF UNABLE TO MAKE SPECIFICATIONS

1. VISUAL CHECK
   Obvious damage
   Missing or unlit tubes
   Wrong control settings
   Improper test equipment

Install a plug-in and turn Type 200 ON	
Set TIME/INCREMENT	100usec
Trigger Source	INT
Trigger Mode	NORMAL

2. POWER SUPPLY VOLTAGES

(a) Adj. -210V ADJ. 10mv ripple	(a) If no power, check Thermal cut-out Replace tubes V101 then V103, then V102, V104 Check line voltage (105-125V) Check R131/R133 ratio Check for open rectifiers - half wave rectification Check C104 Check load
(b) +100V (± 3%) 15mv ripple	(b) Replace tubes Check R115/116 ratio Check for open rectifiers Check C102 Check load
(c) +250V (± 3%) 15mv ripple	(c) Replace Tubes Check R106/R107 ratio Check for open rectifiers Check C101 Check load
(d) -60V (55 volts)	(d) Replace V313 Check R141, C313 Check load for bad diodes or open
(e) Check regulation of all voltages from 105-125 line volts	(e) Recheck (a) (b), etc.

3. DECADE TRIGGER

Put test scope probe on cathodes of V205, V210, etc.
Trigger scope from SYNC OUT of Plug-in

(a) Check unit switching -7 to 10 volt triggers and neon indication of sequential operation

(a) Check UNIT TRIG ADJ.* in plug-in
Try new plug-in or check plug-in procedure
Replace trigger tubes V205, V210, V215, etc.
Replace switching tubes V204, V209, V214, etc.
Remove readout tubes V202, 203, 207, 208, etc. to isolate

Turn all Type 200 Row switches On. Put test scope probe on PRIMARY MATRIX output. Externally trigger scope from SYNC OUT.

(b) Adjust DECADE TRIG ADJ.**
Adjust for optimum position with all 50 increments running. (May require re-adjustment of UNIT TRIGGER* in plug-in)

(b) Check for bad row switch
Replace V317B
Check for 5 volt pulse at grid of V317B
Replace trigger tubes V303, V306, etc.
Replace switching tubes V302, V305, etc.
Replace T201

(c) LINE VOLTAGE vs TRIGGER
Vary line voltage from 105-125V and check continuity of triggering

(c) Same as (b)

(d) Check triggering over entire timing range of plug-in

(d) Check plug-in operation same as (b)

** On some instruments this control may be labeled "VERT TRIG"

* On some Plug-ins this may be labeled "HOR TRIG"

4. READOUT - PRIMARY MATRIX

Turn first 3 or 4 primary matrix controls alternately CW and CCW
Scope probe on PRIMARY MATRIX output

(a) Adj. MATRIX COMP. C201 for squarest and flattest increments

(a) Replace V105
Replace L201

Change TIME/INCR on plug-in to 10usec.
Turn all levels CCW except one.

(b) Adj. H.F. ADJ. L201 for sharpest leading edge

(b) Replace V105
Replace L201

5. READOUT - SECONDARY MATRIX

Place scope probe on SECONDARY MATRIX output and repeat as in step 4.

Repeat step 4, (a) & (b) with C201S and L201S

With Scope on SECONDARY MATRIX bring first 10 secondary levels to mid voltage.
Set TIME/INCR. on plug-in to 100usec.

6. READOUT COMPENSATION

(a) Adjust READOUT LEVEL ADJ. R2000 for best compromise of positive and negative spikes

(b) Adj. secondary READOUT COMP. C2011 thru C2020 for best compromise on the individual switching spikes

(b) Replace corresponding readout tube V203, 208, etc.
Replace trimmer

Put scope probe on PRIMARY MATRIX and observe as in step (b)

(c) Adj. primary READOUT COMP. C2001 thru C2010 as in step (b)	(c) Corresponds to (b)

7. MATRIX OPERATION

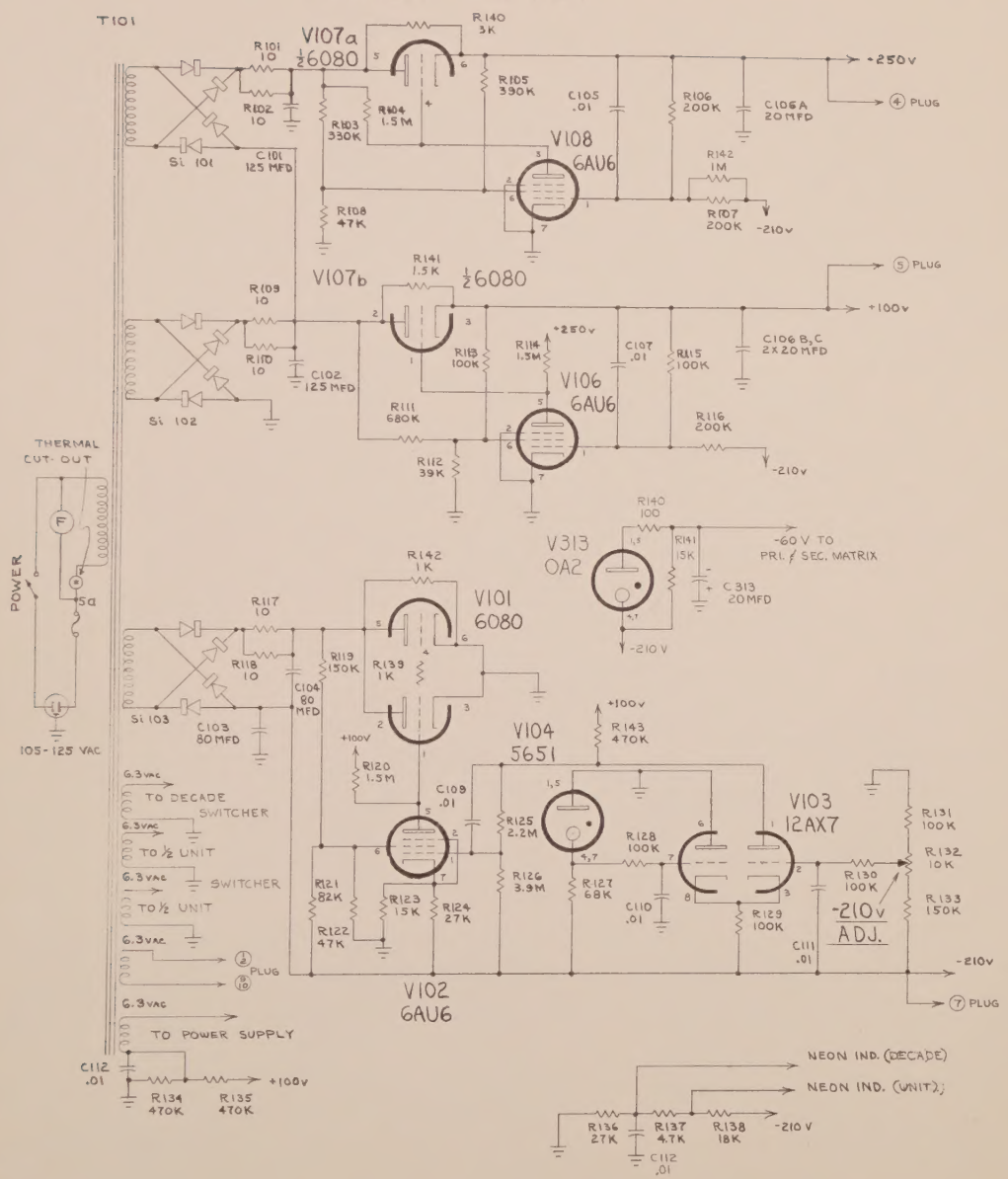
(a) Check full 10V range and general operation of each individual primary and secondary matrix increment	(a) If a vertical row (2nd, 12th, 22nd, etc.) is bad or interacts check corresponding readout tube, V202, 203, etc. If an individual increment - check diode, check pot, check -55 volts
(b) Check neon indicators	(b) Check neon supply voltages Replace bulb

8. DECADE SWITCHING

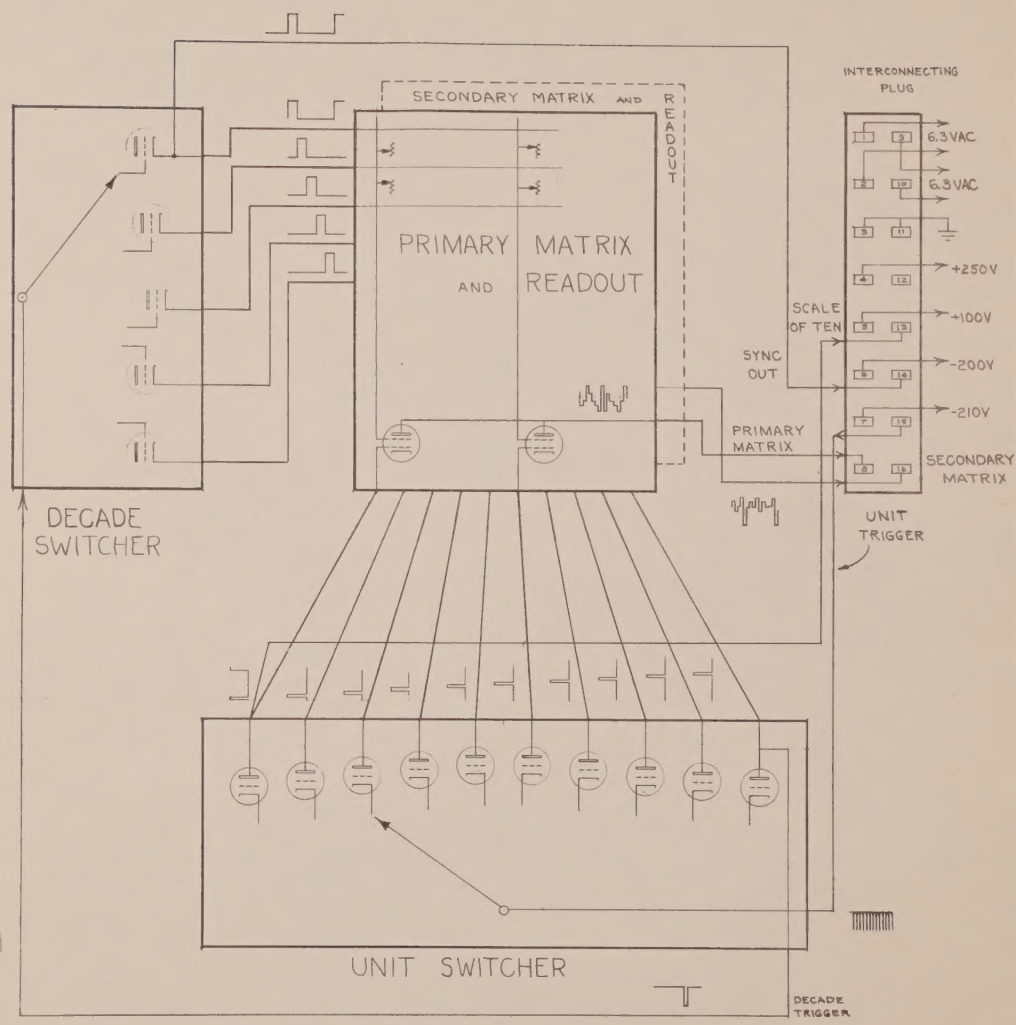
(a) Turn row switches ON & OFF and check proper operation *(Note comment in OPERATING PROCEDURE)	(a) Repeat step 3 (b)
(b) Check neon indication	(b) Check voltage supply and dividers Replace neons

9. AUXILIARY OUTPUTS TO PLUG-IN

(a) SCALE OF TEN	(a) Replace V317 (Recheck decade trigger)
(b) SYNC OUT	(b) Check R359



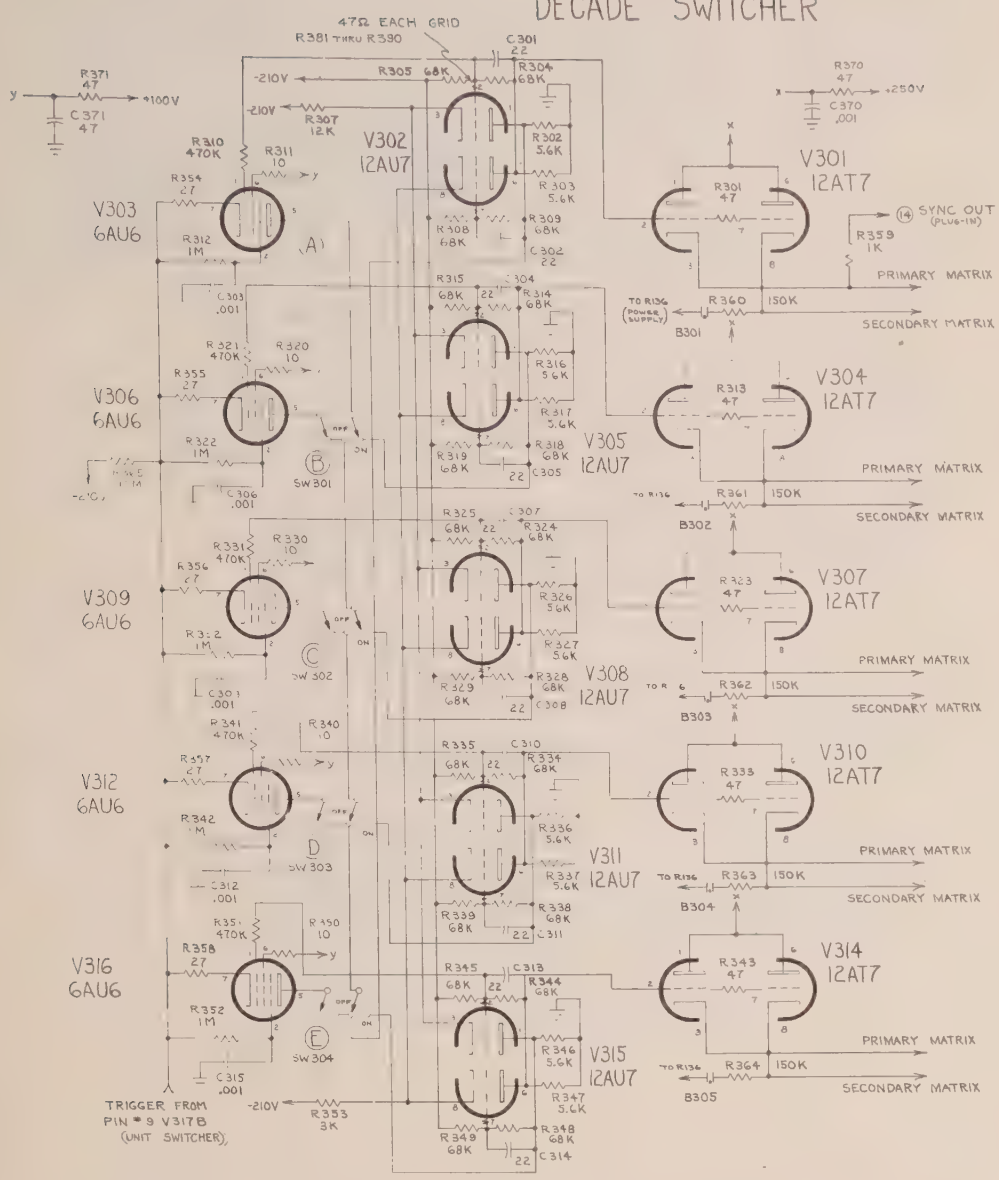
TYPE 200 WAVEFORM SYNTHESIZER 9-27-60 FAT



BLOCK DIAGRAM

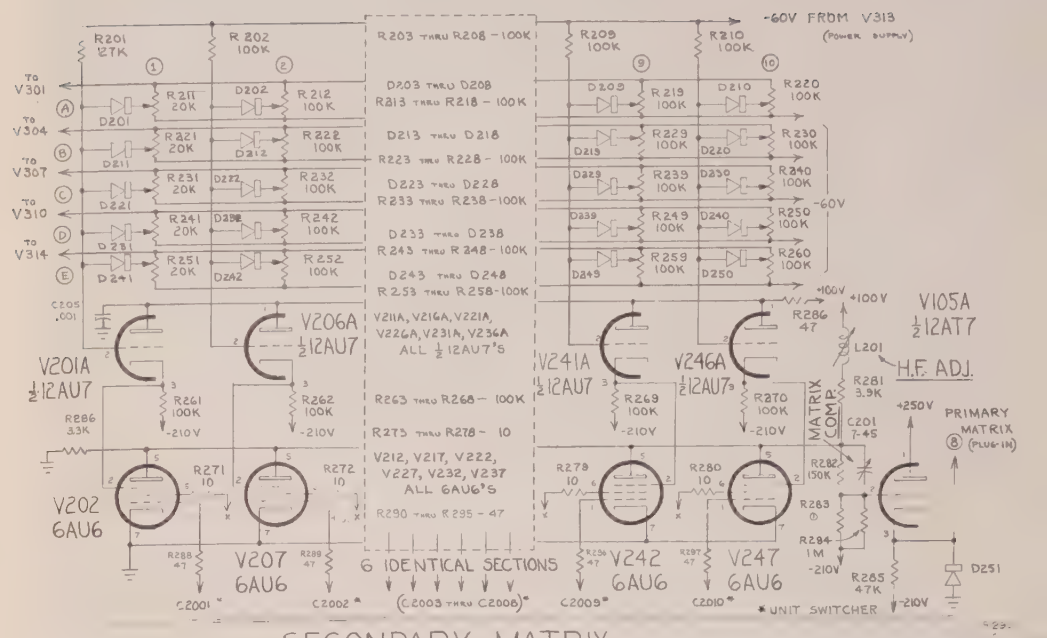
TYPE 200 WAVEFORM SYNTHESIZER 9-27-60 FAT

DECADE SWITCHER

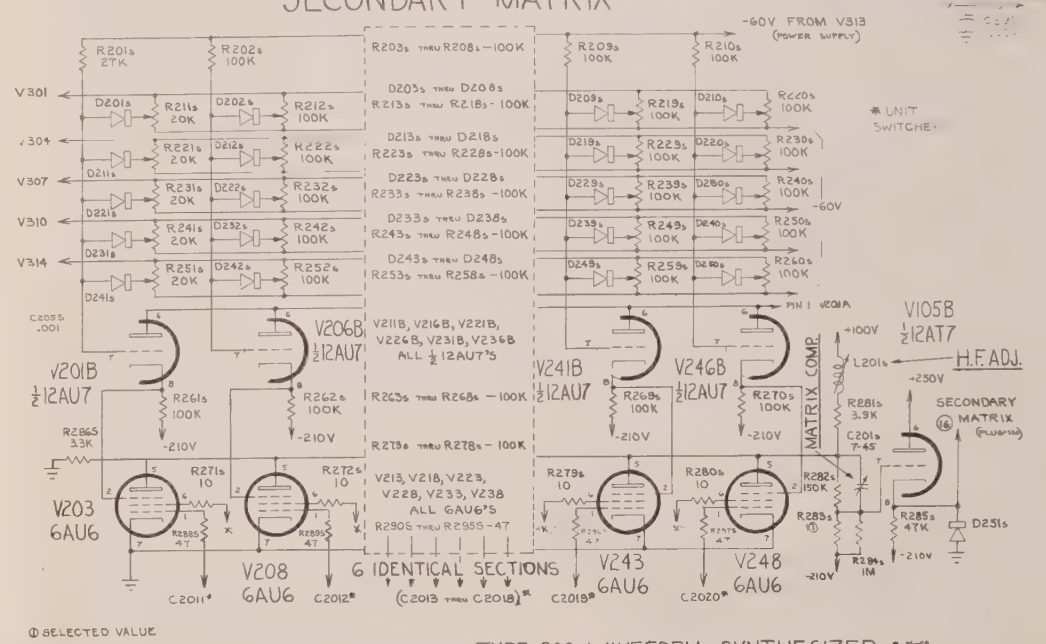


TYPE 200 WAVEFORM SYNTHESIZER

PRIMARY MATRIX

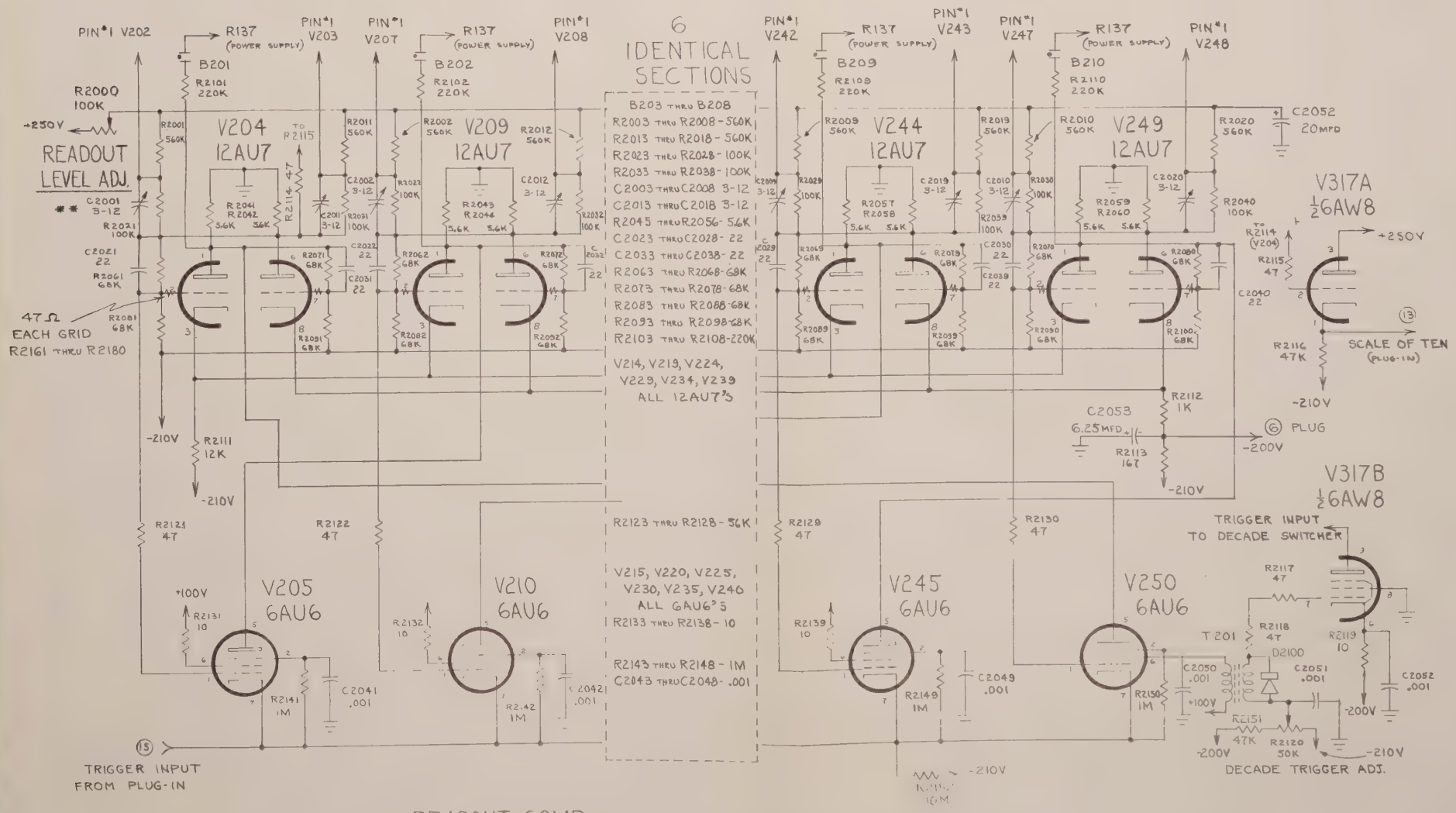


SECONDARY MATRIX



TYPE 200 WAVEFORM SYNTHESIZER

UNIT SWITCHER



** C2001 THRU C2010 ARE PRIMARY READOUT COMP.

* C2011 THRU C2020 ARE SECONDARY READOUT COMP.

TYPE 200 WAVEFORM SYNTHESIZER

OPERATING PROCEDURE

I GENERAL

A. BASIC OPERATION

1. Turn rows C, D, & E OFF in Type 200
2. Turn all Secondary Matrix (red) knobs CCW in rows A & B
3. Set TIME/INCREMENT to 100usec
4. Connect MONITOR or MAIN OUTPUT to scope input
5. Connect SYNC OUT to external trigger input of scope
6. Set TRIGGER SOURCE to INT.
7. Set TRIGGER MODE to NORMAL

You should be observing twenty various voltage levels or increments each having a duration of 100usec. Adjust scope triggering so that #1 increment is at the beginning of trace.

8. Vary the Secondary Matrix (red) knobs and notice the individual widths vary. The overall waveform duration will vary since it is a product of the (number of increments switched) X (width of each increment).
9. Vary the Primary Matrix (black) knobs and notice the individual amplitudes vary.
10. Switch on rows C, D, & E; you should have 50 increments.
11. Change TIME/INCREMENT switch and notice that increment widths vary as a group but the width ratio remains constant.

B. AUXILIARY OUTPUTS AND CONTROLS

1. OUTPUT AMPLITUDE control varies overall waveform amplitude without affecting ratio of individual amplitudes.
2. SYNC OUT is used to trigger monitor scope when you are switching two or more rows.
3. SCALE OF TEN is used to trigger monitor scope when only one row is on.

C. APPLY MAIN OUTPUT TO YOUR CIRCUIT, INSTRUMENT OR SYSTEM

II TIMING

A. TIME/INCREMENT Switch

This switch determines the fixed minimum rates at which the internal trigger generator can run. The actual trigger rate to the increments is controlled by the additional delay which each variable width setting adds in.

B. VARIABLE WIDTH

This is determined for each individual increment by the setting of the Secondary Matrix knobs. When all these knobs are turned to maximum CCW position, the time of each increment corresponds to the setting of the TIME/INCREMENT Switch. When any Secondary Matrix knob is turned CW the time before the next trigger or increment can be generated is extended by the amount of width or delay (up to 10 times the setting of TIME/INCREMENT) added in by that one knob. Each variable width control acts independently of any other.

III TRIGGERING

A. INTERNAL - NORMAL

The operation in this position was fairly well described in I and II. The triggering or increment generation is wholly internal at a rate determined by the TIME/INCREMENT Switch and individual variable width (Secondary Matrix) knobs. The output pulse waveform will be continuously repeating at a time or frequency equal to the product of (number of increments being switched) X (increment width).

B. EXTERNAL - NORMAL

In this position each increment is singly triggered by each external trigger or MANUAL TRIGGER. The increment time or width will be wholly controlled by the external trigger rate AS LONG AS THE TIME/INCREMENT & VARIABLE WIDTH SETTING DOES NOT EXCEED THE TIME BETWEEN EXTERNAL TRIGGERS. For example: If the increment duration as set by the TIME/INCREMENT and variable width setting would have been less than 1msec. on any individual increment, a 500 cycle external trigger rate would produce increments durations of 2msec. However, if the external trigger rate were 10 KC, the increment duration would correspond to the combined TIME/INCREMENT - variable width time.

C. INTERNAL - TEN COUNT

In this position the individual increment width is determined as in the INTERNAL-NORMAL operation. However, any one of the rows of ten increments can be sequentially triggered by the RESET button (manual operation) or externally. The RESET button or an external trigger "unlocks" the next row of ten increments to be switched and lets them run at the rate already determined by the TIME/INCREMENT - variable width combination. The repetition rate cannot exceed the sum of the durations of the ten increments being triggered plus a short "hold-off" time between rows.

When using a monitor scope, trigger it from the SCALE OF TEN in this mode of operation.

D. INTERNAL - PROGRAM COUNT

In this position again, the individual increment width is determined by the TIME/INCREMENT - variable width settings as in INTERNAL-TEN COUNT operation. As in the INTERNAL-TEN COUNT operation, the RESET button or an external trigger unlocks a group of increments, only this time it is the whole program of 20, 30, 40 or 50 increments (depending on how many rows are turned on in the Type 200) that is unlocked. Each trigger will cause the program to start at #1 increment in row A and run sequentially through the number of rows switched ON and return to #1 increment where it will wait for the next trigger. The repetition rate cannot exceed the sum of the duration of all the increments in the full program plus a short "hold-off" time between programs.

When using a monitor scope, trigger it from the SYNC OUT in this mode of operation.

E. EXTERNAL - TEN COUNT OR PROGRAM COUNT

This mode will have very limited application. Pressing the RESET button will "arm" or make the TRIGGER INPUT ready to receive external triggers. The MANUAL TRIGGER or an external trigger can now be used to trigger the increments one at a time through a count of ten or the whole program, depending on the TRIGGER MODE setting.

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The trouble shooting suggestions have been arranged in order of progressive calibration. This is to allow you to more easily isolate the malfunction by its place in the sequence of operation. Since many later steps depend on the proper performance of prior operations, it would be most wise to check back to the beginning on all troubles and eliminate this possibility. For example if you have instability of several increments you might suspect the matrix or, quite logically, the trigger circuits. However, the trouble might well be the -210 volt power supply out of regulation. Eliminate fundamental problems (such as the power cord being plugged in!) before trouble shooting specific areas.

All tests should be made with a voltmeter having 20,000 ohms/volt and a dependable oscilloscope with the following characteristics.

(a) Input impedance at least 1 Megohm
(b) Horizontal sweep accuracy - 3%
(c) Capable of being externally triggered

CALIBRATION SEQUENCE

IF UNABLE TO MAKE SPECIFICATIONS

1. VISUAL CHECK
   Obvious damage
   Missing or unlit tubes
   Wrong control settings
   Improper test equipment

Install "C" unit in checked TYPE 200
Set TIME/INCREMENT to 100usec.
Turn Rows C, D & E OFF in TYPE 200
Turn Secondary Matrix (red) knobs CCW in rows A & B of the TYPE 200
TRIGGER SOURCE ..... INTERNAL
TRIGGER MODE ..... NORMAL

2. POWER SUPPLY VOLTAGES

At interconnecting plug check the following voltages

(a) -210
(b) -200
(c) +100
(d) +250

(a) (b) (c) (d)
Recheck Type 200
Check interconnecting plug

Put probe of test scope on pin 6 of V1
(Miller Run Up Tube)
Trigger scope internally

3. RATE GENERATOR

(a) Adjust RATE GEN STABILITY pot R29 until stable sawtooth appears

(a) Swing MILLER DC BALANCE pot thru its range
Run the RATE TIMING pot thru its range
Replace, one at a time, V1 thru V6
Pull V13

Set scope time to 10msec/div

(b) Adjust RATE TIMING
Adjust R62 for one sawtooth per 10msec

(b) Re-check all Secondary Matrix pots for full CCW
Check V11 and V13
Check Secondary Matrix input at R55. Should be at DC ground
Check Timing Switch components

(c) Adjust MILLER DC BALANCE ADJ. R66
Switch TRIGGER MODE between LOCKOUT and NORMAL
Adjust pot so that DC level observed is nearly the same in both modes. Sawtooth should not run in LOCKOUT MODE

A dual input scope should be used in the next check. Trigger scope from SYNC OUT and simultaneously observe pin 7 of V7 and pin 6 of V1

4. TRIGGER

(a) Check UNIT TRIGGER pulse
This should be a narrow positive going spike of 7 to 10V amplitude. It should exactly coincide with the sawtooth peak

(a) Replace V5 and V6
Reverse secondary or primary leads of T1
Replace T1

Place scope probe on SCALE OF TEN. Trigger scope internally. Turn scope gain up until unit switching spikes are visible on baseline.

(b) Adjust UNIT TRIGGER ADJ.*
R44 for optimum count of ten (observe spikes on baseline)

(b) Re-check 4 (a)
Replace V7
Re-check Type 200
Check UNIT TRIGGER ADJ. pot

(c) Check SCALE OF TEN for occurrence at beginning of each row and output of approx. 35V

Set scope input to DC and place probe on MAIN OUTPUT. Turn several Primary Matrix knobs alternately CW and CCW

5. OUTPUT

(a) Adjust OUTPUT LEVEL R89
for a center ground reference after checking range from 0 to +25V

* On some Plug-ins this may be labelled "HOR TRIG"

(b) Check range of OUTPUT AMPLITUDE R80 pot for 3 to 1 and maximum amplitude of at least 35 volts

(c) Adjust OUTPUT DC BALANCE R88 so that varying OUTPUT AMPLITUDE causes minimum DC shift

(a) (b) (c)
Replace V15, V14, V12
Check the pots

Place scope probe on pin 5, V14

(d) Adjust PRIMARY MATRIX COMP C29 for flat-top square wave

(d) Check Type 200 output
Replace C29
Replace V12

Place scope probe on MAIN OUTPUT

(e) Adjust OUTPUT COMP. C31 for flat-top square wave

(e) Replace V14
Replace C31

(f) Adjust H.F. RESPONSE L1 for best risetime without overshoot

(f) Check R83
Replace L1
Replace V14

Place scope probe on pin 7 of V11.
Turn several Secondary Matrix knobs CW

(g) Adjust SECONDARY MATRIX COMP. C24 for flat-top square wave

(g) Re-check Type 200 output
Replace C24

Monitor MAIN OUTPUT with scope.
Trigger scope from SCALE OF TEN
Set up "C" unit as explained under INTERNAL-TEN COUNT IN OPERATING PROCEDURE
Turn Rows C, D, E, ON in Type 200

6. LOCKOUT

(a) Check TEN COUNT LOCKOUT
Press RESET button and observe sequential row switching
Apply a minimum 10 volt, lusec risetime external trigger and observe sequential row triggering

(a) Replace V8, V9
Check SCALE OF TEN input at SW1A
Check pin 6, V8 for -90V pulse
Check pin 2, V8 for -5V differentiated count of ten
Check V9 grid divider resistors
Check C3 and D1

Set up "C" unit as explained under INTERNAL-PROGRAM COUNT in OPERATING PROCEDURE. Trigger scope from SYNC OUT

(b) Check PROGRAM COUNT LOCKOUT
Repeat 6 (a) Observe full program sequence

(b) Same as 6 (a) with PROGRAM COUNT

Set up "C" unit as explained under EXTERNAL-NORMAL in OPERATING PROCEDURE. Observe neon indication rather than triggering scope.

7. EXTERNAL - MANUAL TRIGGER

(a) Switch TRIGGER SOURCE
Switch between INTERNAL and EXTERNAL and adjust RATE GEN. STABILITY, R29 so that there is no triggering in EXTERNAL

(b) MANUAL TRIGGER
Check operation for sequential triggering of individual increments

(b) Check for 40V spike at junction R20/R21
Check SW2
Replace V8

(c) TRIGGER INPUT
Apply a minimum 10V, 1usec. risetime trigger and check for sequential triggering of one increment per input trigger.

(c) Check D2 & C7
Replace V8

(d) Readjust RATE GEN. STABILITY, R29 to compromise EXTERNAL TRIGGER sensitivity with step (a)

With the scope still on the "C" MAIN OUTPUT, set sweep time to 10msec/div
Turn C, D & E rows off in Type 200
Turn SECONDARY MATRIX controls FULLY CCW
Trigger scope from the SYNC OUT
TRIGGER MODE ..... NORMAL
TRIGGER SOURCE ..... INTERNAL

8. TIMING

(a) Set TIME/INCREMENT at 10msec and adjust RATE TIMING, R62 for exactly one increment per 10msec on scope

Change scope sweep speed to 2usec/div and the TIME/INCREMENT switch to 2usec

(b) Adjust C20L (on TIME/INCREMENT switch) for exactly one increment per 2usec. on scope

Change TIME/INCREMENT to 3.3usec.

(c) Adjust C20K for exactly 6 increments in 20usec

Change scope speed to 10usec/div
Change TIME/INCREMENT to 10usec

(d) Adjust C20J for exactly 1 increment per 10usec

Change TIME/INCREMENT to 33usec

(e) Adjust C201 for exactly 3 increments per 100usec

(f) Check all remaining timing positions for ± 3% accuracy and retrim fast ranges until within ± 3%

(a) thru (f)
Replace V13, V1
Check pot and timing capacitors

(g) Check Variable Width ratio on all ranges for 10 to 1 coverage. Use #2 Secondary Matrix knob in row A

(g) In the 2usec. position Variable Width range may properly be as low as 8 to 1
Replace V13, V1
Check amplitude of Secondary Matrix from Type 200

9. GENERAL OUTPUTS

(a) Check SYNC OUT for positive going, 15 volt gate

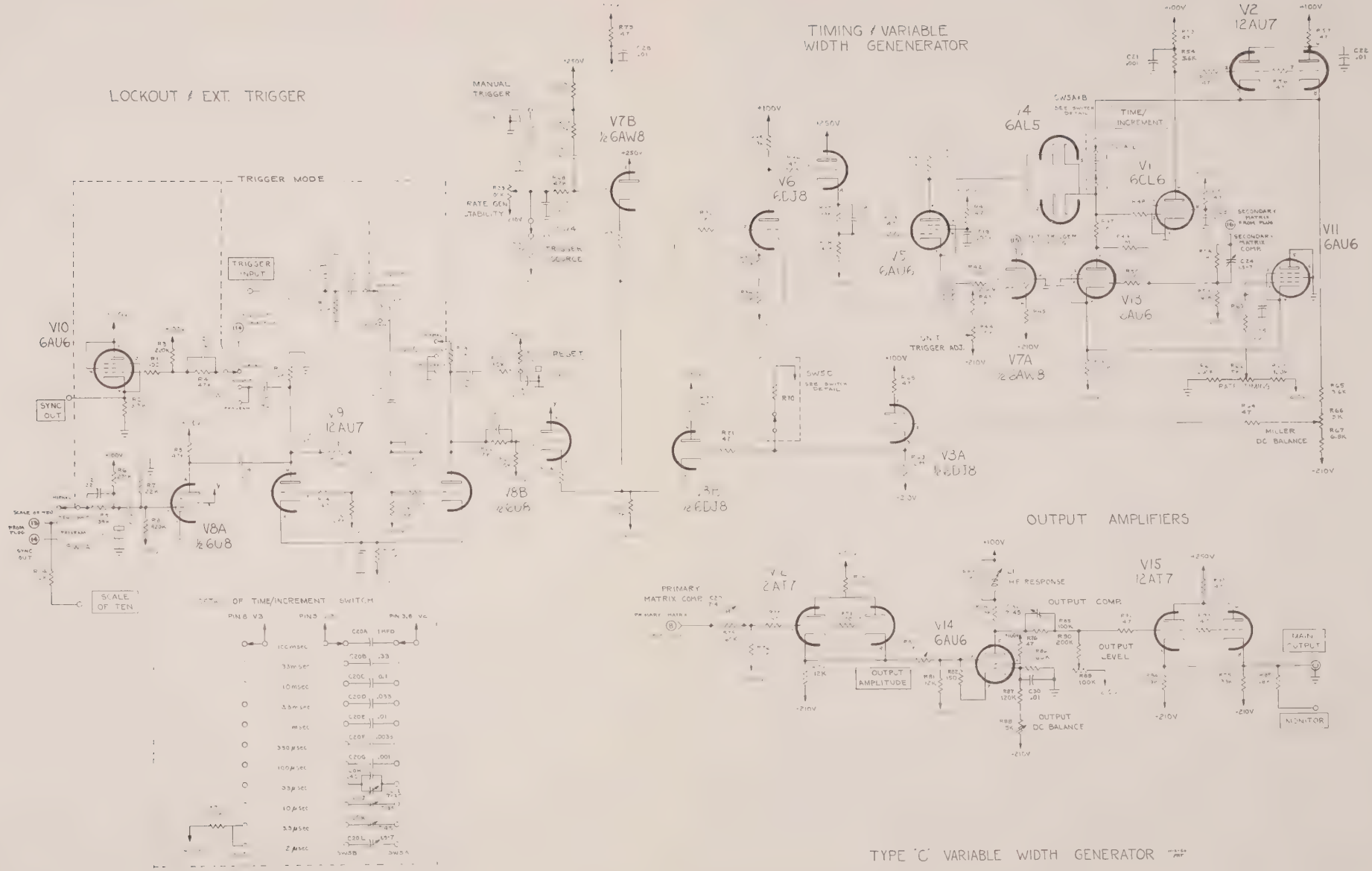
(a) Replace V10

(b) Check output waveform hum for less than 0.1 volt

(b) Change V15, V14

(c) Check incremental time jitter for 1 part in 500

(c) Replace V4, V1

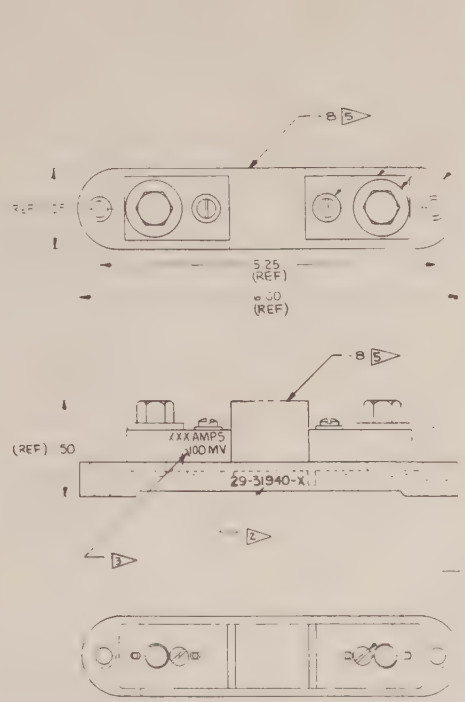

LOCKOUT & EXT. TRIGGER
TRIGGER MODE
TRIGGER INPUT
MANUAL TRIGGER
RATE GEN STABILITY
TRIGGER SOURCE
V10 6AU6
SYNC OUT
V9 12AU7
V8A ½6U8
V8B ½6U8
V7B ½6AW8
V6 6DJ8
V5 6AU6
V3A ½6DJ8
V3B ½6DJ8
RESET
SCALE OF TEN
SCALE OF TEN OF TIME/INCREMENT SWITCH
TIMING & VARIABLE WIDTH GENENERATOR
V4 6AL5
V1 6CL6
V2 12AU7
V3 6AU6
V7A ½6AW8
V11 6AU6
TIME/ INCREMENT
SECONDARY MATRIX COMP.
MILLER DC BALANCE
OUTPUT AMPLIFIERS
V13 12AT7
V14 6AU6
V15 12AT7
PRIMARY MATRIX COMP.
OUTPUT AMPLITUDE
OUTPUT COMP.
OUTPUT LEVEL
OUTPUT DC BALANCE
MAIN OUTPUT
MONITOR
TYPE 'C' VARIABLE WIDTH GENERATOR

VENDOR ITEM - SEE SOURCE CONTROL OR SPECIFICATION CONTROL DRAWING

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVAL

-9971

PROD FILE 25



-1;-2;-3;-4;-5;-6;-7 ASSEMBLY

DASH NO	PRINT AT 25°C
-1	3.3 AMPS
-2	1.65 AMPS
-3	3.3 AMPS
-4	1.65 AMPS
-5	13.4 MILLIAMPS
-6	6.7 MILLIAMPS
-7	AMPS

TABLE I

9101

PRINT NOT VALID AFTER Dec. 3 1964

USE QUANTITY AS REQUIRED SEE 5

4 PART MARK BY RUBBER STAMPING PART NO. AND APPLICABLE DASH NO. PER BAC 5307

5 STEEL STAMP XXX AMPS 100 MV. SEE TABLE I FOR CURRENT VALUES APPLICABLE TO EACH DASH NO.

6 WESTON INSTRUMENT DIV. OF DAYSTROM INC NEWARK N.J. (CODE 65092)

7 MANGANIN SHUNT MATERIAL, THE SIZE, SHAPE, & FORM, FOR EACH SHUNT TO BE DETERMINED BY CERT-CAL LABS AT TIME OF ASSEMBLY MATERIAL WILL BE SUPPLIED BY CERT CAL LABS. METHOD OF ASSEMBLY TO TERMINAL BLOCKS TO BE DETERMINED BY CERT-CAL LABS. FOR SHUNT REQUIRMENTS SEE TABLE I.

FUNCTIONAL TEST

1. EACH SHUNT MUST BE CERTIFIED WHILE CONNECTED TO THE METER IT IS INTENDED TO BE USED WITH (SEE 25-30163 FOR THE METER TO BE USED) THE METER MOVEMENT IN TO THE SHUNT SHALL HAVE 0.065 OHM LEADS. INSTALLATION CALIBRATION, AND CERTIFICATION OF THE SHUNT ELEMENTS SHALL BE ACCOMPLISHED BY CERT-CAL LABS.
2. WHILE CONNECTED TO THE METER EACH SHUNT ... HAVE AN ACCURACY OF ±1% OF ITS CURRENT RATING PER TABLE I.

RELEASE						QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE	MATERIAL	MATERIAL SPEC	HT-TR	FINISH	PT-MK	REV SYM
								LIST OF MATERIAL								
✓	✓	✓	✓	✓	✓	✓	-8	SHUNT MATERIAL			5					
✓	✓	✓	✓	✓	✓	✓	2	MS 35337-5	WASHER							
.	.	.	.	✓	✓	.	2	124959-001	BLOCK-TERMINAL		4					
.	✓	✓	.	✓	✓	.	2	NAS 603-6	SCREW							
✓	✓	✓	✓	✓	✓	✓	.	24929-024	BOLT		4					
✓	✓	✓	✓	✓	✓	✓	2	ND15047-024	WASHER		4					
✓	✓	✓	✓	✓	✓	✓	.	25148-024	WASHER		4					
✓	✓	✓	✓	✓	✓	✓	2	25147-058	BOLT-LEAD		4					
✓	✓	✓	✓	✓	✓	✓	1	31386-001	BASE		4					
—						—	-7	SHUNT ASSY						-	△	
	—					—	-6	SHUNT ASSY						—	△	
		—				—	-5	SHUNT ASSY						—	△	
			—			—	-4	SHUNT ASSY						—	△	
				—		—	-3	SHUNT ASSY						—	△	
					—	—	-2	SHUNT ASSY						—	△	
						—	-1	SHUNT ASSY						—	△	
-7	-6	-5	-4	-3	-2	-1	QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	ZONE	STOCK SIZE	MATERIAL	MATERIAL SPEC	HT-TR	FINISH	PT-MK	REV SYM

APPLICATION				PART NO	RELEASE COLUMN INDICATOR	DRAWING SHEET NUMBER REV SYM
NEXT ASSY	USED ON	SECT NO	SERIAL NUMBER			
25 30 63	WS-133	—		-7		
25 30 63	WS-133	—		-6		
25 30 63	WS-133	—		-5		
25 30 63	WS-133	—		-4		
25 30 63	WS-133	—		-3		
25 30 63	WS-133	—		-2		
25 30 63	WS-133	—		-1		

PT MK	PART MARKING PER BAC 5307
S	STEEL STAMP SEE DETAIL
R	RUBBER STAMP - LOC OPTIONAL
T	TAG
C	CONTROLLED SEE DETAIL FOR TYPE & LOCATION

DRAWING ORIGINATED BY (GROUP) GROUND POWER EQUIPMENT

CHANGE NO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON ANGLES ± DECIMALS ± RIVET & BOLT EDGE MARGINS ± .06 SHEET METAL CORNER RADII INTERNAL 1/16 EXTERNAL 2/32 BEND RADII IF .01 ON .03 & .04 IF .03 ON .09 & GREATER

DIMENSIONING & TOLERANCING PER MIL-STD-8 SEE BAC 5097 FOR SURFACE ROUGHNESS FORM PUNCH STRAIGHTEN & PIT METAL PARTS PER BAC 5300 MATERIAL SUBSTITUTIONS & EQUIVALENTS PER BAC 5005 BOLT & NUT INSTALLATION PER BAC 5009 FOR FINISH CODE SEE DOC D3 5000

		DATE
DRAWN		
CHECKED		3
STRUCT		
ENGR		2-24-64
RELIABILITY		
PROJ		
GROUP		

THE BOEING COMPANY
AERO-SPACE DIVISION SEATTLE WASHINGTON

SHUNT ASSEMBLY

CODE IDENT NO	SIZE	
81205	D	29-31940
SCALE	AF	SH OF

APR 24 1964

LATEST ATTACHMENTS
ADCN
ADCN
ADCN
DDA
51

3-45+3T

DRAFTED	RICHARD BINSCHUS	10-29-64
CHECKED	L. P. Hamer KC	10-29-64
STRESS APPROVAL		
RELIABILITY APPROVAL	Q. BITNEY	
GROUP APPROVAL		
REQUESTED	23660, HOAGLUND, ELRA 094942	

DWG. REC. CLK. Em 11/3 14
RLS 11-3-64
BP GROUP 11-3-64
CHG. NO. PRR 9500
PROD. INFO. P

THE BOEING COMPANY
ADVANCE DRAWING CHANGE NOTICE

THE DWG WILL BE CHANGED TO INCLUDE THIS ADCN

☐ DEVIATION ☒ VARIATION

REASON: PROVIDE REQUIRED GUIDE PINS. TERMINAL BLOCK TOO LONG AND WILL NOT ALLOW SHUNT MATERIAL TO FIT INTO PLACE ON ASSEMBLY. SCREW & WASHER INCORRECT SIZE FOR HOLE.

ISSUE NO. —
USED ON WS-133
SECT. NO. —
CHG EFF —

DWG TITLE: SHUNT - ASSEMBLY

ADCN	DRAWING NO		SH	SEQ NO.
S-1	29-31940	-	1	1

L/M ZONE	REPLACES	7	6	5	4	3	2	1	REQD	PART NUMBER	DESCRIPTION	ZONE	STOCK SIZE	MATL.	MATL SPEC	HT TR	FIN.	PT MK
	NEW	-9	-9	-9	-9	-9	-9	-9	4	▷	GUIDE PIN		.093 DIA. x .30	BRAZING ROD				
1-14		~~V~~	~~V~~	~~V~~	~~V~~	~~V~~	~~V~~	~~V~~	~~2~~	~~124959-001~~								
	NEW	V	V	V	V	V	V	V	2	-9	BLOCK ASSY - TERMINAL						—	2 ▷
	NEW	-9	-9	-9	-9	-9	-9	-9	2	-10	BLOCK - TERMINAL			▷			—	—
1-13										~~NAS603-6~~								
		V	V	V	V	V	V	V	2	NAS602-6P								
1-15										~~MS35337-5~~								
		V	V	V	V	V	V	V	2	MS35337-4								

CHANGE L/M AS SHOWN:

CHANGE FLAG NOTES AS SHOWN:

▷ COMMERICAL ITEM - MAY BE PROCURED THROUGH LOCAL HARDWARE.

ADD ▲ ▷ MAKE FROM 124959-001 WESTON INSTRUMENT. DIV. OF DAYSTROM INC. NEWARK N.J. (CODE 65092)

CHANGE CALLOUT AS SHOWN:

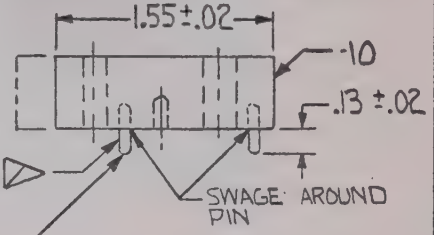
~~NAS 603-6~~ ~~MS35337-5~~ ← DELETE ▲

NAS 602-6P ← ADD ▲
MS35337-4
(2 PLACES) ▲

CHANGE CALLOUT AS SHOWN:

~~124959-001~~ ← DELETE ▲
-9 ASSY ← ADD ▲
(2 PLACES) ▲

ADD -9 ASSY AS SHOWN:



ASSY -9

REF:
FIG A 9219

▲ = ADCN REF ONLY

P NO ASSY COMPLETE.

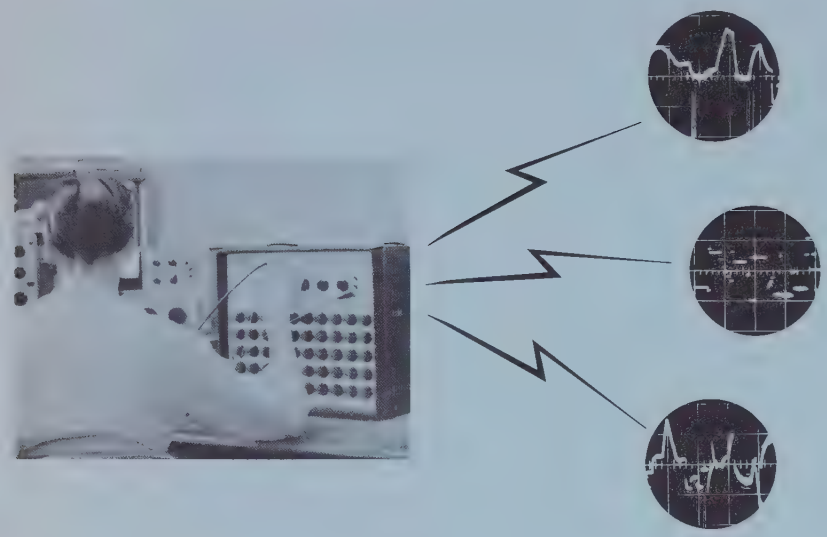
PLNG: Con Boney by C. Giese 10-29-64
QC: [signature]

NEXT ASSY	USED ON	SECT. NO.	SERIAL NUMBER	PART NUMBER	REL COL IND	DRAWING SHEET NUMBER	NEXT ASSY	FINAL ASSY
APPLICATION							QTY REQD	

US 4317 7000 REV. 10/63

2-5142

CONDENSED CATALOG



VAVEFORM SYNTHESIZERS
AND
VOLTAGE CALIBRATORS

EXACT

EXACT ELECTRONICS, INC.
P. O. BOX 552, PORTLAND, OREG.

WAVEFORM SYNTHESIZER

The purpose of the Waveform Synthesizer is to give you the ability to create an output waveform composed small adjustable segments or increments. The various characteristics of each increment such as slope, widt amplitude, time duration, etc., may be varied over a broad range to produce an infinite variety of outputs. T type of plug-in used with the basic unit determines the characteristics you can control.

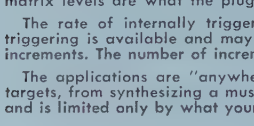
This is a digital device and does not use filtering, integration or harmonic control. Small straight line segmer with no discontinuity between them make up the variety of output waveforms you can synthesize.

The basic Type 200 consists of two groups (primary and secondary matrix), each containing 50 separately variab voltage level controls. These levels are available as auxiliary square wave outputs on several of the plug-ins. T matrix levels are what the plug-ins use to determine the controlling characteristics such as slope and width.

The rate of internally triggering each increment is determined over a broad range by the plug-in. Extern triggering is available and may produce one increment, a row of ten increments, or a whole program of 20 to increments. The number of increments in use can be selected in multiples of 10.

The applications are "anywhere that you need a waveform," from driving a shaker table to simulating rad targets, from synthesizing a musical note to generating a complex telemetry pulse pattern. The unit is self contain and is limited only by what your hand sets it to produce.

TYPE A VARIABLE SLOPE PLUG-IN



The main output from this plug-in can be anything from a simple sawtooth to very complex transient. Up to 50 increments each individually variable in slope a amplitude are available to produce a variety of repetitive output waveforms. Bo primary and secondary matrix outputs offer auxiliary square wave and pul outputs.

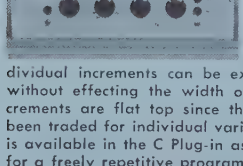
	MAIN OUTPUT	PRI. & SEC. MATRIX
Risetime/Falltime — Increment	0.5 usec.	0.3 usec.
Duration — Increment	3.3 usec. to 1 sec.	3.3 usec. to 1 sec.
Duration — Complete Wave	33 usec. to 50 sec.	33 usec. to 50 sec.
Amplitude — Increment	0 to 50 volts	0 to 10 volts
Amplitude — Complete Wave	15 to 50 volts	10 volts
Reference Level (Increment/Waveform)	−25 volts to +25 volts (adj.)	+7 volts
Slope Range	10 volts, plus or minus	.....
Amplitude Stability — Increment	Within 0.2 volts	Within 0.1 volts
Amplitude Stability — (24 hrs.) Complete Wave	Within 0.5 volts	Within 0.5 volts
Time/Increment Accuracy	5%	5%
Time Stability	1 part/5,000	1 part/5,000
Switching Transient Amplitude	6 volts (except between rows)	1.5 volts (except between rows)
Switching Transient Duration	Less than 0.6 usec.	Less than 0.6 usec.
Output Impedance	Nom. 5K (50V @ 10ma)	Non.. 1K (10V @ 10ma)

Monitor Out ..... Isolated output for scope observation
Sync Out ..... +15V gate occurring at start of each program, 10 increments in duration (Row A)
Scale of Ten Out..... +35V gate occurring every tenth increment
Triggering ..... Internal — Free-running at time/increment rate

PRICE.....$325

f.o.b. factory

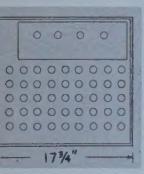
TYPE C VARIAB



The Type C unit output consists of 10, 20, 30, 40 or 50 variable levels each having individual variable widths. The group timing is variable in the same manner as the other plug-ins but on each range individual increments can be extended up to 10 times longer without effecting the width of other increments. All the increments are flat top since the slope characteristic has now been traded for individual variable width. Versatile triggering is available in the C Plug-in as in the F Plug-in, and provides for a freely repetitive program or external triggering of 1, 10 and up to all 50 increments at a time.

Risetime/Falltime—Incr. .....0.3 us
Duration (Min. Width)—Incr..2 usec. to 100 ms
Duration (Min. Width)—
Complete Waveform .....20 usec. to 5 s
Var. Width Range (X Duration).1 to 10, ea. in
Amplitude—Increment ..... 0 to 50 vo
Ampiltude—Cplt. Wfm. .....15 to 50 vo
Ref. Level (Incr./Wfm.)....0 to +25 volts (ac
Amplitude Stability—Incr. .....Within 0.2 v
Amplitude Stability (24 Hrs.)
Complete Waveform .....0.5 v
Time/Increments Accuracy 5
Time Stability 1 part/5
Output Impedance .....Nom. 5K (50V @ 10m

TH PLUG-IN GENERATORS



TYPE 200 SYNTHESIZER

No. of Increments/Row	10
No. of Rows	1, 2, 3, 4, or 5
Triggering (time/incr.)	determined by plug-in
Amplitude	determined by plug-in
Increment Position	indicated by neons
Power	105-125V, 375 watts
Weight	58 lbs.

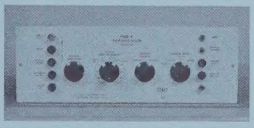
PRICE WITHOUT PLUG-INS

Type 200 ..... **$1575**

Type 200RM (Rackmount).... **1600**

f.o.b. factory

TYPE F VARIABLE SLOPE PLUG-IN



he fundamental operation of the F unit is quite similar to the A Plug-in. The n output of the F units contains "SLOPES" only and permits the setting of accu- continuous waveforms free from transients (continuity meaning each slope is nected to the one preceding and the one following). Since the slopes are vari- e over a 50 volt range and no level setting is required, transient, shock and ech waveforms are readily synthesized. The F unit contains the added advantage ersatile external triggering.

	MAIN OUTPUT/SLOPES	MIXED Pri. Matrix + Slopes	PRI. & SEC. MATRIX
time/Falltime — Increment	Equal to 2 incr. width	0.5 usec.	0.3 usec.
ation — Increment	3.3 usec. to 1 sec.	3.3 usec. to 1 sec.	3.3 usec. to 1 sec.
ation — Complete Wave	33 usec. to 50 sec.	33 usec. to 50 sec.	33 usec. to 50 sec.
olitude — Increment	.....	0 to 50 volts	0 to 10 volts
olitude — Complete Wave	15 to 50 volts	15 to 50 volts	10 volts
e Range	+ and −25 volts	+ and − 25 volts	.....
erence Level (Increment/Waveform)	0 to +25V (adj.)	0 to +25V (adj.)	+7 volts
olitude Stability — Increment	Within 0.3 volts	Within 0.3 volts	Within 0.1 volt
e/Increment Accuracy	5%	5%	5%
e Stability	1 part/5,000	1 part/5,000	1 part/5,000
put Impedance	Nom. 5K (50V @ 10ma)	Nom. 5K (50V @ 10ma)	Nom. 10K (10V @ 1ma)

TRIGGERING:

: Out	15V gate occurring at start of each program, 10 increments in duration (Row A)
e of Ten Out	35V gate occurring every tenth increment
rnal	Running at time/incr. rate
rnal	20V—1 usec. trig. produces single incr.
ual	Each trigger produces one increment
Count Lockout	Manual or external trigger generates rows of 10 increments sequentially
gram Lockout	Manual or external trigger generates program of 20 or more increments

PRICE.....**$300**

f.o.b. factory

IDTH PLUG-IN

itor Out	Use Scope Only
: Out	15V gate occurring at start of each program, 10 increments in duration (Row A)
e of Ten Out	35V gate occurring every tenth increment

TRIGGERING:

rnal	Running at time/increment rate
rnal	20V—1 usec. trig. produces single incr.
ual	Each trigger produces one increment
Count Lockout	Manual or external trigger generates rows of 10 increments sequentially
ram Lockout	Manual or external trigger generates program of 20 or more increments

PRICE.....**$300**

f.o.b. factory

¾% VOLTAGE CALIBRATORS

—TYPE 100 SPECIFICATIONS—

OUTPUT

Accuracy: ±¾ % of full scale

Voltage: 2 mv to 100 v—peak to peak in 9 steps
Continuously variable

Frequency: DC or direct coupled 1 kc square wave—
Positive going from ground

Risetime: Less than 2 μsec

Symmetry: ±0.05%

Impedance: 1 to 2200 ohms

GENERAL

Power: 105 to 125 volts—50-60 cycles

Size: 10½" x 6¼" x 6"

Weight: 10 pounds

Accessories: 52 ohm output cable

Includes: Male BNC each end
BNC to UHF Adapter
2-wire power cord adapter

Price.....$285
f.o.b Factory

—TYPE 105 SPECIFICATIONS—

Same as the above Type 100 with the addition of a 60 cycle chopper-comparator permitting the mixing of any unknown voltage with the internal ¾% reference for comparision on an oscilloscope.

Price.....$335
f.o.b. Factory

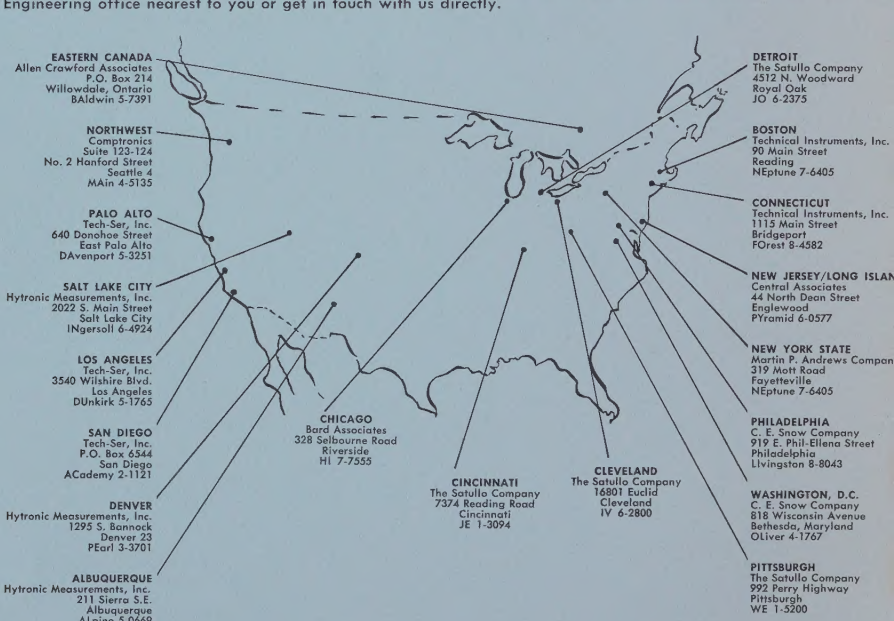
—RACK MOUNTED CALIBRATORS

The Type 100RM and Type 105RM are 7" high panel mounted units having the same specifications as the standard models.

Type 100 RM.....$310 **Type 105 RM.....$360**

It is the intent of Exact to bring you instruments which are *exactly* right for your applications. This means work ing with you at the beginning to assure that you get the right piece of equipment and then providing you with th maximum field service thereafter for the life of the instrument.

The products of Exact, Inc., are warranted for a period of one year to be free from defective workmanship an materials. If you have any question regarding service, applications or purchasing, please contact the Exact Sale Engineering office nearest to you or get in touch with us directly.



EXACT ELECTRONICS, INC. P.O. BOX 552, PORTLAND, OREG